federal register

Friday
September 7, 1979

Part V

Department of Energy

Water Heaters; Final Rule Amending Test Procedures

DEPARTMENT OF ENERGY

10 CFR Part 430

Energy Conservation Program for Consumer Products; Final Rulemaking Amending Test Procedures for Water Heaters

AGENCY: Department of Energy.

ACTION: Final rule.

SUMMARY: The Department of Energy amends its test procedures for water heaters to specify a new measure of water heater capacity, first hour rating. These test procedures are a part of the energy conservation program for consumer products established pursuant to the Energy Policy and Conservation Act, as amended by the National Energy Conservation Policy Act, which requires that standard methods of testing be prescribed for covered products.

EFFECTIVE DATE: October 9, 1979.

FOR FURTHER INFORMATION CONTACT:

James A. Smith, U.S. Department of Energy, Office of Conservation and Solar Applications, Mail Station 2221C, 20 Massachusetts Avenue, N.W., Washington, D.C. 20585. 202–376–4814.

Robert M. Mussler, U.S. Department of Energy, Office of General Counsel, Mail Station 3224, 20 Massachusetts Avenue, N.W., Washington, D.C. 20585. 202–376–4100.

SUPPLEMENTARY INFORMATION:

A. Background

Title III, Part B of the Energy Policy and Conservation Act (Act) (Pub. L. 94–163) established an energy conservation program for consumer products. As part of this program, section 323 (42 U.S.C. 6293) of the Act requires that standard methods of testing to determine estimated annual operating cost and at least one other useful measure of energy consumption be prescribed for certain products, including water heaters.

Test procedures for water heaters were proposed by notice issued April 21, 1977 (42 FR 21576, April 27, 1977). Final test procedures for water heaters were prescribed on September 27, 1977 (42 FR 54110, October 4, 1977). DOE amended the test procedures for water heaters by notice issued October 13, 1978 (43 FR 48986, October 19, 1978) in order to specify a new method of determining the measure of efficiency of water heaters.

When originally proposed on April 21, 1977, the test procedures for water heaters included the measures of hot water supply rating and recovery rate. Hot water supply rating was a measure of the maximum amount of hot water that a water heater could provide in one hour. Recovery rate was a measure of the rate at which a water heater could heat water. Both of these measures were included in the original proposed test procedures because they were likely to assist consumers in making purchasing decisions.

At the public hearing on the original proposed water heater test procedures, members of the water heater industry argued that, because of the way the term "basic model" was defined, the test procedures as proposed were unduly burdensome for the testing of electric water heaters with immersed heating elements. The proposed definition would have required the testing of a large number of models.

After reviewing those comments, a decision was made to revise the definition of a water heater basic model for the final test procedures to exclude immersed heating elements from consideration as a distinguishing feature of a basic model. This revision of the definition of a water heater basic model solved the burdensome issue but made the proposed method for the determination of hot water supply rating unworkable.

Since hot water supply rating was a useful measure of the capacity of a water heater, members of the water heater industry expressed concern over the possible loss of this measure. They commented that the hot water supply rating of an electric water heater with immersed heating elements could be predicted by calculation; however, they had no such calculation method to present at the time, nor did they submit any data from which a hot water supply rating calculation method might be developed.

While the development of a method for predicting the hot water supply rating of such a water heater was considered feasible, it was found that, lacking a proven hot water supply rating calculation method and test data from which to attempt to develop such a method, the proposed measure, hot water supply rating, had to be deleted from the final test procedures for water heaters. However, a statement was included in the notice of the final rule on test procedures to the effect that further investigations into methods for the calculation of hot water supply rating or for the determination of some other measure of hot water delivery performance for water heaters would be made. It was further stated that the water heater industry and other interested parties were invited to participate in these investigations.

No comments on the original proposed test procedures for water heaters addressed the measure of recovery rate. This measure, sometimes referred to as "recovery capacity," accounted for the combined effect of a water heater's power input and recovery efficiency on the rate at which the water heater could heat water. In the proposed test procedures, recovery rate was to be determined independently of hot water supply rating and was intended to serve as a useful measure of the rate at which a water heater could recover from a large hot water draw.

Revising the definition of a water heater basic model also made the proposed method for the determination of recovery rate unworkable. Again, lacking a proven recovery rate calculation method and the test data from which to attempt to develop such a method, this proposed measure, like hot water supply rating, had to be deleted from the final test procedures.

The investigation into methods for the prediction of hot water supply rating and recovery rate for the determination of some other measure of hot water delivery performance for water heaters was concluded by DOE at about the same time that two events occurred which reaffirmed the need for such measures to be included in the test procedures for water heaters. The first of these events was the release of the Federal Trade Commission's (FTC) final staff report on FTC's proposed rule concerning disclosure of energy cost and consumption information in labeling and advertising of consumer products. This report was released on February 12, 1979. In it, FTC made the following statement in the section dealing with the determination of the capacity of consumer products covered by the proposed rule:

> "Historically, gas and oil water heater sales are based on recovery capacity, while electric water heater comparisons are based on storage capacity. Some participants [in the public hearing and written comments] argued that the traditional methods of comparing water heaters are unsatisfactory. A system that reflects the energy needed both to store and to replace consumed hot water is more informative than one that measures only storage or recovery. The Recommended Rule reservedly bases capacity on tank storage, in accordance with current DOE test procedures. If the Department of Energy prescribes methods of measuring first hour recovery rates or hot water supply ratings before the Commission issues the final labeling rule, staff recommends that the final rule reflect the DOE procedure for measuring capacity in effect at that time."

The second event was the series of six public meetings held on DOE's advanced notice of proposed rulemaking regarding energy efficiency standards for nine types of consumer products. These public meetings were held over

the period January 26 to February 8, 1979. Four of the participants in these public meetings, all representatives of the water heater industry, made statements to the effect that DOE should use first hour rating as the measure of the capacity of a water heater and issue minimum energy efficiency standards which are a function of this capacity measure. (As it is used here, first hour rating can be considered to be equivalent to hot water supply rating.) These commenters claimed that the establishment of an energy efficiency standard based on a fixed energy factor value for water heaters of a given energy source would impose a more stringent requirement on water heaters with large tank volumes than those with small tank volumes. Such an approach would discriminate against water heaters with large tank volumes. It was pointed out that water heaters with large tank volumes provide a utility which cannot always be matched by those with smaller tank volumes, particularly in the case of electric water heaters. Commenters argued that consumers need electric water heaters with large tank volumes to satisfy their hot water needs in order to take advantage of off-peak or time-of-day electric utility rates to reduce their water heating energy bill.

By notice issued May 3, 1979 (44 FR 27191, May 9, 1979), DOE, in an effort to develop a more useful measure of water heater capacity, proposed to amend the test procedures for water heaters to incorporate two new measures, recovery rate and first hour rating.

Recovery rate, as proposed, was the same as it appeared in the original proposed test procedures except that a new method of determining the power input of an electric water heater with immersed heating elements was specified. Also, as proposed, recovery rate was to be used in the determination of first hour rating.

First hour rating, as proposed, was a measure conceptually equivalent to hot water supply rating as it appeared in the original proposed test procedures for water heaters. This new name for the measure was deemed more descriptive since it both identified the time base of the measure, an hour, and by the use of the term "first," implied that the measure was only indicative of the performance of the water heater during its "first" hour of operation. While the consumer will not know the conditions for the determination of this measure, it is sufficient that the term will discourage the interpretation of the measure as a rate of hot water delivery performance which the water heater can maintain hour after hour. The proposed method for determining first hour rating differed from that originally proposed for determining hot water supply rating. Hot water supply rating was to be determined entirely by test. First hour rating, as proposed, was to be determined partially by test and partially by calculation. This new method for determining the measure was intended to reduce the test burden without sacrificing accuracy.

A public hearing on the proposed amendment was held on June 27, 1979.

B. Discussion of Comments

Three speakers, all representatives of the water heater industry, testified on the proposed amendment to the test procedures for water heaters at the public hearing. Six written comments concerning the proposed amendment had been received by July 18, 1979. Five of the written comments were submitted by representatives of the water heater industry. The sixth was submitted by a water heater retailer. Although some of these written comments were received after the close of the written comment period on July 9, 1979, all were considered in the development of this final rule.

The following is a discussion of the issues raised in the testimony presented at the public hearing and in the written comments submitted to the docket. The comments have been analyzed by topic, rather than source, since in many cases the same or similar comments were received from more than one source.

1. *First hour rating and the Federal Trade Commission's labeling rule.* All commenters expressed the concern that DOE was proposing to amend its test procedures for water heaters to specify a new measure of capacity, first hour rating, at a time when FTC was preparing to issue a final rule for the labeling of water heaters which would require the disclosure of a different measure of capacity, storage capacity. This concern prompted most of the comments submitted.

Several commenters addressed the need for using first hour rating as the measure of the capacity of a water heater. First hour rating was cited as a true measure of a water heater's ability to do work, i.e., deliver hot water on demand, and the measure which should serve as the basis for making meaningful comparisions between all types of water heaters. It was remarked that storage capacity, the only measure of the capacity of a water heater included in DOE's test procedures at the time, suffices only as a measure of a water heater's ability to store water. While commenters acknowledged that consumers would usually be able to make meaningful comparisons between water heaters of like energy source on the basis of storage capacity, they pointed out that meaningful comparisons could not be made between water heaters of different energy sources based on storage capacity alone. The basis for the commenters' remarks concerns the contribution of a water heater's recovery rate to its hot water delivery performance. Typically, for water heaters of like energy source and like storage capacity, recovery rate will not vary greatly. Therefore, the contribution of recovery rate to the hot water delivery performance of water heaters of like energy source may be accounted for implicitly in the approach taken to "size" a water heater to a given application. However, a different sizing approach would have to be used for each water heater energy source since the contribution of recovery rate to hot water delivery performance will usually vary greatly between water heaters of like storage capacity but different energy sources. Typically, an electric water heater has a much lower recovery rate than a gas water heater which, in turn, typically has a much lower recovery rate than an oil water heater. Thus for a given application, the sizing approach that is appropriate for gas water heaters may indicate that a unit with a storage capacity of 30 gallons would suffice while the sizing approach that is appropriate for electric water heaters may indicate that a unit with a storage capacity of 50 gallons would be required. To present a different sizing approach for each water heater energy source for the purpose of enabling consumers to make comparisons between water heaters of different energy sources would complicate the water heater labels and the consumer education process associated with the labeling program. Using first hour rating, valid comparisons may be made between water heaters of both like and unlike energy sources. Adopting first hour rating as the measure of the capacity of a water heater would avoid all of the difficulties described above.

Several comments were made to the effect that DOE should not amend the test procedures for water heaters to specify the new measure, first hour rating, if FTC, prior to issuing its final labeling rule, is not going to replace storage capacity with first hour rating as the measure of the capacity of a water heater. It was argued that such an amendment to the test procedures for water heaters would be pointless if FTC were not to require the disclosure of the

new measure on the label for water heaters.

Also of concern was the prospect that FTC might proceed with issuing its final labeling rule utilizing storage capacity as the measure of the capacity of a water heater and then revise it at some future date in order to require the use of first hour rating in place of storage capacity. It was argued that such a switch in the labeling requirement would disrupt consumer education programs based on the original labels and confuse the consumer. During such a transition period consumers might attempt to make comparisons between water heaters when some might bear a label disclosing storage capacity while the labels on other water heaters might disclose first hour rating. Commenters also remarked that such a switch would impose additional costs associated with the printing of new labels for water heaters. These cost would have to be passed on to consumers.

Concern was also expressed over the possibility that FTC might delay the labeling rule for water heaters if DOE were to finalize its test for first hour rating as it was proposed. The water heater industry projected that a delay of the labeling rule for water heaters would severely complicate the consumer education process regarding the use of the consumer product labels.

FTC staff attended DOE's public hearing regarding its proposed amendment to the test procedures for water heaters. Additionally, FTC staff has been provided with copies of all submissions to the docket regarding this proposed rulemaking. DOE and FTC staff have discussed the issues raised in testimony at the public hearing and in submissions to the docket which concern the FTC labeling program. FTC staff has indicated that they continue to support their recommendation to the (Federal Trade) Commission that the final labeling rule for water heaters should reflect the DOE procedure for measuring water heater capacity in effect at the time that the labeling rule is issued. Following these discussions, DOE staff resolved to issue a final rule to amend its test procedures for water heaters in time to permit FTC to adopt first hour rating in place of storage capacity as the measure of the capacity of a water heater and issue its final labeling rule with no delay in schedule. The timing of today's issuance has been coordinated with FTC staff to assure avoidance of the potential problems discussed above.

2. *The burden of testing and methods for determining first hour rating.* All of the water heater manufacturers who submitted comments claimed that the proposed amendment would impose a substantial test burden on the water heater industry. The burden that was of concern was not the incremental additional test time and cost of determining first hour rating as part of a complete test of a water heater in accordance with the existing test procedures, but the burden of having to test a water heater solely to determine its first hour rating. In anticipation of FTC's labeling requirement, the water heater manufacturers claimed that they had already commenced, and to a large extent completed, testing water heaters in accordance with DOE's test procedures. This testing has been done in order to be able to supply FTC with the energy consumption and cost of operation figures which manufacturers expect FTC to require to be submitted 60 days after the issuance of its final labeling rule. DOE's proposed amendment would, if finalized, require that manufacturers perform the proposed first hour rating test on all of the models of water heaters for which the tests for energy consumption and cost of operation had been completed. The effort and expense of such further testing would impose a burden significantly greater than the burden that would have been sustained had the tests for first hour rating been performed at the same time as all other tests.

Comments were made that the timing of DOE's rule to amend the test procedures and FTC's rule to prescribe labels for water heaters would impose an unreasonable test burden. If DOE were to issue its final rule to amend the test procedures for water heaters as it was proposed and in time for FTC to revise its rule prescribing labels for water heaters, the water heater industry could have as little as 60 days in which to accomplish all testing in order to be able to present the test results to FTC on time.

While some manufacturers said that it would be possible for them to meet such a requirement should it be imposed, a trade association for members of the water heater industry expressed concern for other manufacturers, particularly those with limited test facilities or none at all. The trade association claimed that water heater manufacturers would need six months to conduct the tests once they were published.

It was further remarked that such a test requirement would not only impose significant test costs which would be passed on to consumers, but it would also divert manpower and resources from product development work on new energy efficient designs of water heaters. Several cost estimates were presented for such a retesting program. The trade association estimated the cost to be as high as $18,000 per company. One manufacturer estimated labor costs at $27,000 and an additional $19,000 expense to reclaim the test units for sale. Another manufacturer estimated his test cost at $12,000 and commented that his firm would have to build units expressly for test purposes since his firm manufactures to order and not to stock. A third manufacturer estimated his additional test cost would be at least $10,000.

Concern was also expressed over the possibility that, in order to provide more time for completing required testing, FTC might delay the labeling rule for water heaters if DOE were to finalize its test for first hour rating as it was proposed. Commenters projected that a delay of the labeling rule for water heaters would severely complicate the consumer education process regarding the use of consumer product labels.

The manufacturers commented that none of these problems which they had identified concerning DOE's proposal for determining first hour rating by test would be encountered if DOE were to accept their recommendation that first hour rating be predicted by calculation. All of the water heater manufacturers who submitted comments supported this recommendation and offered first hour rating calculation formulas. The industry trade association did the same. All of the proposed formulas followed the same approach toward calculating first hour rating. However, there were some detail differences which would cause slight differences in the calculated values.

All but one water heater manufacturer offered data in support of their suggested first hour rating calculation formulas. The data submitted compared the results of determining first hour rating by test with the results of using the commenter's suggested calculation formula. The results showed general agreement between the results determined by calculation and those determined by test. In most cases the calculated value differed from the test value by less than three percent.

Several of the water heater manufacturers and the trade association acknowledged that there may be some designs of water heaters for which their suggested formula would yield overly conservative results, i.e., up to ten percent below the value that would be determined using the proposed first hour rating test. These would be the designs which do an extraordinary job of limiting mixing of hot and cold water in the tank during a water draw. To avoid

underestimating the first hour rating of a water heater of such innovative design, it was suggested that water heater manufacturers be provided the option of conducting a test to determine the first hour rating of such a water heater.

DOE finds that data submitted by the water heater industry and data generated by the National Bureau of Standards substantiate that first hour rating can be calculated for water heaters of conventional design with a small sacrifice in accuracy over the proposed test method. DOE concurs with comments that a formula for calculating first hour rating may yield overly conservative results for water heaters of innovative design. DOE also finds that the test burden that would be imposed at this time on water heater manufacturers by the proposed rule outweighs the benefits of requiring first hour rating for water heaters to be determined exclusively by test when first hour rating can be calculated with only a slight sacrifice in accuracy in most cases. Further, DOE agrees that the alternative of FTC granting relief to water heater manufacturers by delaying the issuance of the final labeling rule for water heaters to allow sufficient time for testing water heaters to determine first hour rating could be accompanied by some confusion among consumers. In addition, the slight gain in the accuracy of the measure disclosed on the label that is determined by test rather than by calculation does not outweigh the adverse impact of denying useful information to consumers making water heater purchasing decisions for a period of time equal to any delay.

Based on these findings, DOE has modified the requirement of its proposed rule to allow first hour rating to be calculated or determined by test, at the manufacturer's option for the period of time beginning on the effective date of today's rule and ending on November 30, 1979. Beginning December 1, 1979, manufacturers will be required to determine first hour rating exclusively by test. The formula for calculating first hour rating prescribed by today's rule was developed with the intent that it would yield results which would be equal to or slightly less than the results which would be obtained by testing.

The primary intent of these provisions is to enable manufacturers to supply FTC with first hour ratings for all existing models of water heaters, either by testing or by calculation, within a 60 day period following September 20, 1979, the latest date that FTC currently projects for the issuance of its final labeling rule. However, by prescribing a formula for calculating first hour rating which yields a result which tends to be slightly lower than that which can be obtained by testing, DOE has provided an incentive for manufacturers to perform the first hour rating test if they have access to test facilities and if, in their own judgment, the benefit of a slightly higher first hour rating justifies the cost of testing.

It is also the intent of these provisions to insure that first hour rating for all new basic models of water heaters shall be determined exclusively by test since DOE does not find that the prescribed test is burdensome when it is conducted as part of a complete test of a water heater in accordance with the test procedures for water heaters.

Should it become clear at some time that the date by which FTC will require manufacturers to submit energy consumption and cost of operation figures, including first hour ratings, for water heaters will be later than November 30, 1979, DOE will consider extending this termination date of its option for allowing first hour rating to be calculated or determined by test.

3. *Determining First Hour Rating by Testing.*

a. *Full versus partial testing.* For determining the first hour rating of a water heater by testing, one commenter remarked that the proposed test method which required only one water draw was far better than the test method previously proposed for determining the conceptually equivalent measure, hot water supply rating, which allowed for more than one water draw. Another commenter remarked exactly the opposite. This dissenting commenter claimed that by providing for only one water draw to be made the proposed test method would discriminate against the best water heaters on the market, i.e., those with both high recovery efficiencies and power input to storage capacity ratios. The commenter remarked that such water heaters could recover from the initial water draw, i.e., achieve another thermostat cutout, within the one hour period that is the time base of the first hour rating measure. It was claimed that the test method for determining first hour rating previously proposed would, by allowing for additional water draws over the one hour period of the test, yield a better measure of first hour rating than the lower result that would be obtained with the proposed test method.

DOE has considered the commenter's recommendation that DOE adopt the previously proposed test method for determining hot water supply rating as the test method for determining first hour rating. DOE finds that while the results obtained using the commenter's recommended test method may differ from those obtained using the proposed method, this difference will be small in comparison to the magnitude of the results. Moreover, the proposed test method is a significantly less burdensome test than that recommended by the commenter. DOE rejects the commenter's recommendation on these grounds.

The same commenter who recommended that the previously proposed hot water supply rating test be used to determine first hour rating also offered an alternative to this recommendation. The suggested alternative was to modify the proposed approach for calculating the contribution of recovery rate to the first hour rating measure, i.e., the amount of water that a water heater can heat and make available over the one hour time base of the first hour rating measure. The commenter's position was that the time period for this calculation should be one hour minus the time duration from the start of the water draw to the time that the main burner or heating element begins operating rather than the time period of one hour minus the time duration of the water draw itself. The commenter remarked that the main burner of a gas water heater would ignite within fifty seconds to two minutes after the start of the water draw while the water draw itself will last several minutes longer. It was claimed that this shortcoming of DOE's proposed approach would result in an error of five gallons in the first hour rating of one of the commenter's water heaters. The trade association echoed this commenter's position that for determining first hour rating, the contribution of recovery rate should be calculated over the period of time of one hour minus the time duration of the water draw until the main burner or heating element begins operating.

Concerning the recommendation that, for the proposed test method, the contribution of recovery rate should be calculated over the period of time of one hour minus the time duration of the water draw until the main burner or heating element begins operating, DOE finds that this could lead to "double accounting" of hot water. For some water heaters, notably electric water heaters and gas water heaters with low power input to storage capacity ratios, operation of the heating elements or main burner during the water draw test has little effect on the amount of water withdrawn from the water heater. In other words, nearly the same amount of water could be withdrawn from the water heater during the test even if the

heating elements or main burner was prevented from operating during the water draw. However, for other water heaters, notably oil water heaters and gas water heaters with high power input to storage capacity ratios, the effect of main burner operation has a significant effect on the amount of water that can be withdrawn. Therefore, some of the water heated by the operation of the main burner during the water draw test would be accounted for in the amount of water withdrawn from the water heater during the test. Adoption of the commenter's recommendation would allow full credit in the calculated recovery rate contribution term for all water that could be heated by the main burner over the period of the water draw. Thus, some amount of water could be accounted for twice, once in the water draw test and again in the calculated recovery rate contribution term, resulting in an inflated first hour rating for such water heaters. DOE rejects the commenters recommendation on this basis, but finds that the proposed method for the determination of first hour rating would discriminate against some water heaters by not fully accounting for the amount of water heated by the operation of the heating elements or main burner of a water heater during the water draw test. Therefore, DOE has modified its approach for the determination of first hour rating to insure that all water heaters are treated equally. By today's rule, section 3.7 of the test procedures for water heaters requires that the water draw test be conducted with all electrical power or fuel to the heating elements or main burner interrupted to prevent their operation. Section 3.7 further requires that the elapsed time from the start of the test until the first thermostat acts to operate the heating elements or main burner be recorded. The contribution of recovery rate to the first hour rating measure will be calculated over the period of time of one hour minus this elapsed time. Thus, the calculated recovery rate contribution term will account for all of the water that could be heated by a water heater over the one hour time base of the first hour rating measure while the results of the water draw test will account for only the contribution of a water heater's capability to deliver hot water from storage. Summing these two terms to yield first hour rating will account for all of the hot water that could possibly be delivered by a water heater over a one hour period.

b. *Water draw test temperature drop.* Two comments were made concerning the specification in the proposed water draw test of a 40°F outlet water temperature drop. Both commenters were concerned that the specified temperature drop was excessive and would lead to inflated values of first hour rating for water heaters which, in turn, could lead consumers to purchase water heaters of insufficient capacity to satisfy their needs. One commenter remarked that a 20°F temperature drop specification would be more appropriate for the water draw test in light of recommendations being made to consumers to lower their water heater thermostats to as low as 120°F. It was claimed that consumers who operate their water heaters at these recommended thermostat settings will run out of usable hot water well before incurring a 40°F outlet water temperature drop but in most cases not before incurring a 20°F outlet temperature drop.

The commenters are of the opinion that significantly different first hour rating water draw test results will be obtained if instead of specifying 40°F as the outlet water temperature drop, a smaller temperature drop is specified. DOE does not share this opinion. DOE finds that, for current water heater designs, an outlet water temperature drop specification of 40°F will yield water draw test results only slightly greater than those that would be obtained using a 20°F temperature drop specification. This is because current water heater designs inhibit dilution of the stored hot water with the incoming cold water when subjected to a water draw. Thus, when subjected to the water draw test, these designs of water heaters exhibit a relatively constant outlet water temperature or an outlet water temperature which falls off only very slowly until most of the hot water has been withdrawn at which time there is a rapid drop of more than 40°F.

While DOE does not agree with the commenters' contention, i.e., that the outlet water temperature drop specification of the first hour rating water draw test has a significant effect on the results of the test, DOE does find merit in the recommendation that 20°F be specified as the outlet water temperature drop for this test. Should a water heater manufacturer introduce a new design of water heater which does not inhibit dilution of the stored hot water with the incoming cold water when subjected to a water draw, conducting the water draw test using 20°F as the outlet water temperature drop specification will yield a more representative first hour rating than that which would have been determined had 40°F been used as the outlet water temperature drop specification. By today's rule, section 3.7 of the test procedures for water heaters specifies 20°F as the temperature drop for the first hour rating water draw test.

c. *Impact on water heater utility.* A commenter expressed concern that the proposed first hour rating water draw test would encourage manufacturers to produce water heaters which do not maintain a relatively constant outlet water temperature when subjected to a water draw. The commenter remarked that, through widely recognized industry standards, the water heater industry has encouraged water heater designs that can deliver the major portion of a water heater's storage capacity at a relatively constant outlet water temperature nearly equal to the initial outlet water temperature when subjected to a water draw. The commenter pointed out that the utility of such designs is that consumers can enjoy a relatively constant water temperature for personal applications, e.g., bathing and showering, without having to continually adjust the hot and cold water flow rates to account for fluctuations in the hot water supply temperature. The commenter remarked that DOE's proposed rule would adversely affect this utility. By not accounting for the energy associated with the water withdrawn from the water heater, the commenter pointed out that for a given water heater design more favorable results could be obtained with the proposed test if it were possible to modify the design of the water heater to cause the outlet water temperature to drop off more quickly during the course of the water draw. It was pointed out that, all other things being equal, the amount of water that could be withdrawn from a water heater which is capable of maintaining a relatively constant outlet water temperature will be less than the amount of water that could be withdrawn from a water heater which induces dilution of the stored hot water with the incoming cold water (i.e., in such a fashion that the outlet water temperature would fall gradually through the temperature drop specified for the proposed first hour rating water draw test). A greater total volume of water could be withdrawn from the water heater in the latter case because a significant amount of the incoming cold water would be withdrawn as a result of dilution. In the former case, very little cold water would be withdrawn in addition to the stored hot water withdrawn. Further, the greater the outlet water temperature drop specified, the greater the amount of cold water

that could be withdrawn in the latter case, and the greater the disparity between the results of the first hour rating water draw tests for the two different water heater designs.

Changing the outlet water temperature drop specification for the first hour rating water draw test from 40°F to 20°F lessens the magnitude of the problem identified by the commenter but has not eliminated the source of the problem.

When referencing industry standards which encourage water heater designs which deliver hot water at a relatively constant temperature when subjected to a water draw, DOE assumes that the commenter was referring to, for gas water heaters, section 2.14 of the American National Standard for Gas Water Heaters, Volume I, designated ANSI Z21.10.1a–1978, and, for electric water heaters, section 4.4. of the American National Standard for Household Automatic Electric Storage-Type Water Heaters, designated ANSI C72.1–1972. DOE is not aware of the existence of a widely recognized standard which encourages this type of design for oil water heaters. However, since the first hour rating of a typical oil water heater is primarily a function of its high recovery rate rather than its small storage capacity, the effects of dilution during the first hour rating water draw test, if any, will have little effect on the first hour rating measure. DOE considered the approaches taken by these standards for possible application to the test method for determining first hour rating. DOE found that a test approach similar to the one taken by the ANSI Z21.10.1a–1978 standard for gas water heaters could be developed for the first hour rating water draw test which would neither encourage nor discourage water heater designs which induce dilution of stored hot water with incoming cold water when subjected to a water draw. The approach prescribed today considers the energy content of the water withdrawn from the water heater during the first hour rating water draw test. It adjusts, on an energy basis, the measured volume of water withdrawn to an equivalent, or adjusted, volume of water of equal energy content that would have been withdrawn from the water heater if the discharge water temperature had remained constant at its initial value. For water heater designs which inhibit dilution of the stored hot water with the incoming cold water during the first hour rating water draw test, this new approach will yield results nearly equal to the results that would have been obtained using the proposed test method. However, for water heater designs which permit such dilution, this new approach will yield results significantly lower than the results that the proposed test method would have yielded.

This new approach has been incorporated in the test procedures for water heaters by modifying section 3.7 to require that the outlet water temperature be recorded at 15 second intervals throughout the duration of the first hour rating water draw test and by modifying section 4.8 to multiply the actual volume of water withdrawn from the water heater during the first hour rating water draw test by the mean of the recorded values of outlet water temperature divided by the initial outlet water temperature. This approach accounts for the energy content of the water withdrawn from the water heater. The frequent outlet water temperature readings can be used to trace how the energy content of the water withdrawn from the water heater changes with time. Thus, the product of the mean of the recorded values of outlet water temperature and the actual volume of water withdrawn from the water heater during the test is proportional to the energy content of the water. Dividing this product by some reference temperature, in this case the initial outlet water temperature, yields the equivalent amount of water which, at that reference temperature, would have the same energy content.

These modifications to the proposed test method result in a negligible increase in the test burden associated with the proposed test method.

d. *Rate of hot water withdrawal.* Two commenters recommended using a three gallon per minute withdrawal rate for the water draw test. They contended that a three gallon per minute flow rate is more representative of typical hot water withdrawal rates encountered in the home. The point was made that industry standards specify a three gallon per minute flow rate for testing water heaters. To DOE's explanation that a five gallon per minute flow rate had been specified in the proposed test method in order to reveal whether or not the design of the water heater fostered dilution of the discharge water, one commenter remarked that DOE's proposed test method would, by use of the higher flow rate, exaggerate the effects of dilution.

DOE finds that it is not unusual for hot water to be withdrawn from a household water heater at rate on the order of five gallons per minute or more. Such a flow rate is typical of the hot water fill demands of clothes washers and dishwashers.

First hour rating is intended as a measure to be used to properly size a water heater to a particular application. The procedure for sizing the water heater involves making an estimate of a reasonable "worst case" hot water demand that would occur over a one hour period and selecting a water heater with a first hour rating of nearly equal magnitude.

DOE finds that the five gallon per minute (plus or minus 0.25 gallons per minute) flow rate specification that was proposed for the first hour rating water draw test is appropriate for the purposes of using first hour rating to properly size a water heater to a particular application. Therefore, no change has been made to this specification in today's final rule.

e. *Timing the water draw test.* A water heater manufacturer proposed that DOE allow the duration of the first hour rating water draw test to be calculated by dividing the volume of water withdrawn from the water heater during the water draw test by the product of the nominal water withdrawal rate of five gallons per minute and the conversion factor, sixty minutes per hour. The point was made that adoption of this suggestion would eliminate the requirement for timing the duration of the water draw test.

Changes to the test procedures made in response to comments discussed previously under "Impact on water heater utility" require the use of a clock during the first hour rating water draw test. DOE finds that nothing would be gained by adopting the commenter's suggestion. It has not been adopted.

f. *Using the results of the water draw test for more than one basic model.* One commenter remarked that there are various models of gas and oil water heaters which utilize essentially the same tank and water inlet (dip tube) design but differ in power input rating. The commenter recommended that, in cases such as this, the manufacturer should be allowed to conduct the water draw test on one model of water heater and then calculate the first hour rating for the other gas and oil water heaters which are of the same tank and water inlet design but have different power inputs. It was argued that DOE permits a similar scheme for determining the first hour rating of electric water heaters with immersed heating elements.

Because the water draw test was modified in response to comments previously discussed under "Full versus partial testing", the requirement to separately test basic models of water heaters which differ only by the power input has been eliminated.

g. *Recovery rate calculation.* One commenter recommended that water heater manufacturers be permitted to use the nominal or design power input rating for the heating elements or main burner of a water heater for calculating its recovery rate in all cases, not just in the case of electric water heaters as proposed by DOE. The point was made that this would present the power input in nominal terms which the consumer has recognized through the years. By nominal or design power input rating, DOE assumes that the commenter intended for the rating which appears on the manufacturer's nameplate to be used. These ratings usually appear in rounded terms, e.g., 30,000 Btu per hour for a gas water heater.

DOE allows water heater manufacturers to use the design power ratings for the immersed heating elements they install in electric water heaters for calculating the recovery rate of an electric water heater because DOE has found that it would be unnecessarily burdensome to require testing of all models of electric water heaters to determine actual power input. However, since measurement of actual power input for gas and oil water heaters is already required by the test procedures for water heaters, DOE does not find that use of the measured value in the recovery rate calculation presents a problem. Finally, since recovery rate is also a function of the recovery efficiency of a water heater, and recovery efficiency is a measure determined by test and affected by the power input of the water heater tested, DOE finds that it is more accurate to use the actual power input and recovery efficiency of a water heater as determined by testing for calculating the recovery rate of the water heater. Therefore, DOE has not adopted the commenter's recommendation.

4. *Predicting first hour rating by calculation.* Five different formulas for predicting first hour rating by calculation were suggested by as many commenters. All of the proposed formulas shared the approach of summing two terms, the first term being some large percentage of the tank capacity and the second term being the product of the recovery rate of the water heater and some period of time. The first term was intended to predict the amount of hot water that could be withdrawn from storage on demand. The second term was intended to predict the amount of water that could be heated and made available by the water heater over the one hour period that is the time base of first hour rating.

DOE's proposed rule for the determination of first hour rating shared this approach but required that a water heater be tested to determine the amount of hot water that can actually be withdrawn from storage. The amount of water that can be heated and made available by a water heater, the second term of DOE's first hour rating quantity, was to be determined by taking the product of the recovery rate of the water heater and a period of time equal to one hour less the elapsed time of the water draw test.

For determining the first term of the first hour rating quantity, two of the suggested formulas multiply a water heater's actual storage capacity, determined in accordance with DOE's test procedures, by 0.90. The rationale offered for this recommendation was that a quantity of water equal to about 90 percent of the actual storage capacity of a water heater would closely approximate that amount which would be withdrawn from the water heater following DOE's proposed water draw test.

A third formula would determine the first term by multiplying a water heater's rated storage capacity by 0.95 and then multiplying the result by 0.90. By use of the term "rated storage capacity" DOE assumes that the commenter is referring to storage capacity as rated in accordance with section 2.26 of the American National Standard for Gas Water Heaters, Volume I, designated ANSI Z21.10.1–1975, or section 3.8 of the American National Standard for Household Automatic Electric Storage-Type Water Heaters, designated ANSI C72.1–1972.

DOE is not aware of the existence of a widely recognized standard specification for rating the storage capacity for an oil water heater; however, since the specifications for rating the storage capacities of gas and electric water heaters referenced above are identical, DOE has evaluated the suggested formula as if the rated storage capacity for an oil water heater were specified in an equivalent fashion. The referenced standards specify that the actual storage capacity of a water heater must be within plus or minus five percent of the rated storage capacity. By multiplying the rated storage capacity of a water heater by 0.95, as is done in the suggested formula, the minimum allowable actual storage capacity for a water heater of a given rated storage capacity would be used to calculate the first term of the first hour rating quantity. This "adjusted" rated storage capacity term would then be multiplied by 0.90 to account for amount of water which would be withdrawn from the water heater following DOE's proposed water draw test.

The fourth proposed formula would determine the first term of the first hour rating quantity in the same fashion as the third formula would for gas and oil water heaters but would use the value 0.90 in place of 0.95 for determining the adjusted rated storage capacity of an electric water heater. In this case, DOE assumes that the commenter intended to refer to storage capacity as rated in accordance with the method specified in section 25.1 of the American National Standard for Household Electric Storage-Tank Water Heaters, designated ANSI/UL 174–1977. This standard requires the actual storage capacity of an electric water heater to be not less than 90 percent of the rated storage capacity.

A fifth proposal for predicting the first term of the first hour rating quantity would require water heater manufacturers to calculate the minimum amount of water that could theoretically be withdrawn from a water heater to satisfy the water draw requirement of section 2.14 of the ANSI Z21.10.1–1975 standard for gas water heaters and section 4.4 of the ANSI C72.1–1972 standard for electric water heaters. In the case of gas water heaters, this minimum amount of water would be determined by multiplying the actual storage capacity of the water heater by 0.60. In the case of electric water heaters, this minimum amount of water would be determined by multiplying the actual storage capacity of the water heater by 0.80 for water heaters having an overall tank height greater than 36 inches, or by 0.70 for water heaters having an overall tank height less than or equal to 36 inches. No recommendation was made concerning how to calculate the first term of the first hour rating measure for oil water heaters.

In the case of the suggestion that water heater manufacturers use the hot water delivery requirements specified in industry standards to calculate the amount of water to use in place of the results of the water draw test for determining first hour rating, DOE finds that gross underestimates may result. DOE rejects this calculation method because it would yield unreasonably low results for some water heater designs based on the data considered under this rulemaking.

Concerning the suggested calculation methods which would use the adjusted rated storage capacity of a water heater instead of its actual storage capacity, DOE finds no merit in using the adjusted rated storage capacity of a water heater

in a calculation for which the actual rated storage capacity of the water heater has already been determined by test. Further, adoption of this suggested calculation method would penalize water heater manufacturers who rate the storage capacity of their water heaters conservatively. DOE rejects the suggestion that the adjusted rated storage capacity of a water heater be used to calculate first hour rating for these reasons.

Common to all but one calculation method was the contention that the result of the first hour rating water draw test for a water heater would be nearly equal to ninety percent of the actual storage capacity or the adjusted rated storage capacity of the water heater. (The exception was the suggested calculation method, discussed above, that would use the hot water delivery requirements specified in industry standards.) DOE finds that the data submitted by the water heater industry and that generated by NBS substantiates the commenters' contention. For most water heaters the test data and the results of the suggested calculation method agree within plus or minus three percent. However, this data also reveals that this suggested calculation method may overestimate the results of the first hour rating water draw test for some water heaters by as much as six percent.

In keeping with DOE's position that the formula for predicting first hour rating to be included in the test procedures for water heaters should yield results which agree closely with the results that would be obtained through testing but which are unlikely to exceed such test results, DOE has adjusted the commenters' suggested formula for calculating the results of the first hour rating water draw test to yield results six percent lower. This was accomplished by revising the formula from 0.90 times the actual (or adjusted rated) storage capacity of a water heater in gallons, to 0.85 times the actual storage capacity of a water heater in gallons.

The comments which pertained to the proposed method for calculating the amount of water that could be heated and made available by a water heater over the one hour period that is the time base of the first hour rating measure, the second of the two terms of each suggested formula for predicting first hour rating by calculation, were addressed in the preceding section. The determinations made in response to these comments apply here as well.

As mentioned previously, DOE has followed the approach of the proposed test method for determining first hour rating for the purposes of developing a formula for calculating first hour rating. According to the proposed test method, the time duration for calculating the contribution of recovery rate to the first hour rating measure is one hour minus the time duration of the water draw. For the purposes of the formula for calculating first hour rating, this time period can be determined by dividing the predicted quantity of water withdrawn from the water heater during the water draw, i.e., 0.85 times the storage capacity of the water heater in gallons, by the product of the nominal water withdrawal rate of five gallons per minute and the conversion factor, sixty minutes per hour. Carrying out the mathematics, this will simplify to 0.0028 times the storage capacity. Therefore, the second term of the formula for predicting first hour rating by calculation becomes the product of the recovery rate of the water heater and the quantity, one minus the product of 0.0028 and the storage capacity of the water heater.

Section 4.8 of the test procedures for water heaters, prescribed today, presents the complete formula for calculating first hour rating.

5. *Miscellaneous.* After careful consideration of all of the comments, DOE has made some editorial and minor technical changes that were not discussed above and incorporated them in the final rule prescribed today.

C. *Regulatory Analysis Review.*

The proposed rule has been reviewed in accordance with Executive Order 12044 and DOE Order 2030. From the regulatory analysis performed, it was determined that the proposal was significant in nature but did not have major impacts to manufacturers and consumers (imposing annual economic costs of $100 million or more).

(Energy Policy and Conservation Act, Pub. L. 94–163, as amended by Pub. L. 95–619; Department of Energy Organization Act, Pub. L. 95–91.)

In consideration of the foregoing, Part 430 of Chapter II of Title 10, Code of Federal Regulations is amended as set forth below, effective October 9, 1979.

Issued in Washington, D.C., August 30, 1979.

Maxine Savitz,

Deputy Assistant Secretary, Conservation and Solar Applications.

1. Appendix E to Subpart B of Part 430 is amended by adding a new section 3.7 to read as follows:

3.7 *First hour rating water draw test.* Establish normal water heater operation with the maximum mean tank temperature within the range specified in section 2.6 and with all air eliminated from the tank. Begin the first hour rating water draw test immediately after a cutout by recording the hot water outlet water temperature, recording the time, and withdrawing water from the water heater through the hot water outlet at a rate of 5.0±0.25 gallons per minute. Interrupt electrical power to the heating elements or fuel to the main burner of the water heater to prevent their operation during this test. Collect all of the water withdrawn from the water heater during the test in a suitable container for the purpose of determining its weight at the conclusion of the test. Alternatively, a water flow meter may be used to measure the volume of water withdrawn from the water heater directly. Beginning 15 seconds after the start of the test and at every subsequent 15 second interval throughout the duration of the water draw, record the outlet water temperature. For the purposes of this test, the maximum recorded temperature shall be referred to as the initial outlet water temperature, T_o. Monitor the functioning of the water heater thermostats and record the time that a thermostat on the water heater acts to operate a heating element or the main burner. Continue the withdrawal of water until the outlet water temperature drops to a value 20°F below the initial water temperature, at which time terminate the withdrawal. Determine the weight of the water withdrawn, W, in pounds measured with an error no greater than 2 percent, or the volume of water withdrawn, G, in gallons measured with an error no greater than 2 percent. Determine the arithmetic mean of the outlet water temperature readings recorded, T_m, in °F. Determine the elapsed time of the test prior to a thermostat on the water heater acting to operate a heating element or the main burner, t_e, in hours measured with an error no greater than 2 percent. If a thermostat on the water heater does not act to operate a heating element or the main burner within one hour after the start of the test, the test is to be terminated and t_e expressed as one hour.

2. Appendix E to Subpart B of Part 430 is amended by adding a new section 4.7 to read as follows:

4.7 *Recovery rate.*

4.7.1 *Recovery rate for gas and oil water heaters.* For a gas or oil water heater, calculate the recovery rate, R, expressed in gallons per hour and defined as:

$$R = \frac{P \times Er}{k \times \Delta T_5}$$

where—

k is as defined in section 4.1.1.

ΔT_5 is as defined in section 4.3.

E_r is as calculated in section 4.1.1.

P = power input to the burner, determined in accordance with section 3.2.1, expressed in Btu per hour.

4.7.2 *Recovery rate for electric water heaters.* For an electric water heater,

calculate the recovery rate, R, expressed in gallons per hour and defined as:

$$R = \frac{P^* \times E_r \times 3{,}412\ \text{Btu/kWh}}{k \times \Delta T_5}$$

where—

k is as defined in section 4.1.1.

ΔT_5 is as defined in section 4.3.

E_r is as calculated in section 4.1.2 for electric water heaters with other than immersed heating elements, or section 4.1.3 for electric water heaters with immersed heating elements.

P^* = P, power input to the heating elements, expressed in kilowatts, determined in accordance with section 3.2.1 for electric water heaters with other than immersed heating elements or section 3.2.2 for electric water heaters with immersed heating elements, with the following exception: For electric water heaters with dual immersed heating elements which, in characteristic operation of the water heater, are not energized simultaneously at any time, P^* shall be taken as the design power rating of the heating element in closest proximity to the hot water outlet of the water heater, expressed in kilowatts.

3. Appendix E to Subpart B of Part 430 is amended by adding a new section 4.8 to read as follows:

4.8 *First hour rating.*

4.8.1 *Method for determining first hour rating.* Except as provided in section 4.8.2, first hour rating shall be determined in accordance with section 4.8.3.

4.8.2 *Options for determining first hour rating.* Until December 1, 1979, first hour rating may be determined in accordance with either section 4.8.3 or section 4.8.4.

4.8.3 *First hour rating determined by testing.* Calculate the first hour rating, F, expressed in gallons and defined as:

$$F = \left(\frac{W}{d} \times \frac{T_m}{T_o}\right) + \left[R \times (1 - t_c)\right], \text{ or}$$

$$F = \left(G \times \frac{T_m}{T_o}\right) + \left[R \times (1 - t_c)\right]$$

where—

R is as calculated in section 4.7.1 for gas and oil water heaters, or section 4.7.2 for electric water heaters.

W = weight of the water withdrawn from the water heater during the first hour rating water draw test, determined in accordance with section 3.7, expressed in pounds.

d = 8.25 pounds per gallon, the nominal density of water.

G = volume of water withdrawn from the water heater during the first hour rating water draw test, determined in accordance with section 3.7, expressed gallons.

T_m = arithmetic mean of the outlet water temperature readings recorded during the first hour rating water draw test, determined in accordance with section 3.7, expressed in °F.

T_o = initial outlet water temperature recorded during the first hour rating water draw test, determined in accordance with section 3.7, expressed in °F.

t_c = elapsed time of the first hour rating water draw test prior to a thermostat on the water heater acting to operate a heating element or the main burner, determined in accordance with section 3.7, expressed in hours.

4.8.4 *First hour rating determined by calculation.* Calculate the first hour rating, F, expressed in gallons and defined as:

$$F = (0.85 \times V) + \left\{R \times \left[1\ \text{hour} - \left(0.0028 \frac{\text{hour}}{\text{gallon}} \times V\right)\right]\right\}$$

where—

V is as defined in section 4.1.1.

R is as calculated in section 4.7.1 for gas and oil water heaters, or section 4.7.2 for electric water heaters.

0.85 = the constant multiplier for calculating the results of the first hour rating water draw test.

0.0028 hour/gallon = the constant multiplier for calculating the duration of the water draw during the first hour rating water draw test, determined by dividing 0.85, as defined in this section, by the product of the hot water withdrawal rate during the first hour rating water draw test, five gallons per minute, and the conversion factor, 60 minutes per hour.

[FR Doc. 79-27906 Filed 9-6-79; 8:45 am]

BILLING CODE 6450-01-M